REMARKS

Claims

Claims 1-10 and 21 remain in the application with claim 1 being in independent form. Claims 1, 8, and 21 have been amended to further clarify the invention. There is full support in the specification as originally filed for the amendments to claims 1, 8, and 21. No claims have been added or canceled as part of this Amendment.

Double Patenting

Claims 1-3, 5, 6, and 8-10 stand provisionally rejected on the ground of nonstatutory obviousness-type double patenting as being unpatentable over claims 1, 2, 6, 7, and 9-11 of copending Application No. 10/924,270. Although a Terminal Disclaimer has not been submitted in conjunction with the present Amendment, Applicants are prepared to submit such a Terminal Disclaimer in the future upon an indication of allowable subject matter by the Examiner.

Claim Rejections – 35 U.S.C. §112, first paragraph

Claims 1-10 and 21 stand rejected under 35 U.S.C. §112, first paragraph, as failing to comply with the written description requirement. According to the Examiner, the claims contain subject matter which was not described in the specification in such a way as to reasonably convey to one skilled in the art that the inventors, at the time the application was filed, had possession of the claimed invention. With respect to claims 1-10, the Examiner points out that the limitation of the powder/gas conditioning chamber being "different from the gas/powder exchange chamber" is not supported by the written description. Applicants respectfully disagree and contend that Figure 3 clearly shows that the powder/gas conditioning chamber 80 is not the same as the gas/powder exchange chamber 49, i.e., it is "different" than the gas/powder exchange chamber 49. Nonetheless, Applicants have amended claim 1 to recite that the powder/gas conditioning chamber 80 is "downstream"

from the gas/powder exchange chamber 49 to overcome the rejection to claims 1-10. With respect to dependent claim 21, the Examiner states that the limitation of the temperature of the particles being increased "at least 150 degrees Kelvin as a result of the powder/gas conditioning chamber" is not supported by the written description, but requires an upper limit of 250 degrees Kelvin as stated in paragraph [0041]. Applicants submit that paragraph [0041] refers to an example in which the powder/gas conditioning chamber is approximately 240 millimeters in length and that the specification and drawings fully support dependent claim 21 and a rise in particle temperature of at least 150 degrees Kelvin without an upper limit. Nevertheless, dependent claim 21 has been amended to overcome this rejection to place this application in condition for allowance.

Claim Rejections – 35 U.S.C. §112, second paragraph

Claims 1-10 and 21 stand rejected under 35 U.S.C. §112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which Applicant regards as the invention. In particular, the Examiner believes the limitation of the powder/gas conditioning chamber being "different" than the gas/powder exchange chamber is unclear. This limitation has been removed from independent claim 1 to overcome this rejection. The Examiner also believes that the terms "increasing" and "residence time", which were added in the previous Amendment, render independent claim 1 unclear. While Applicants believe that independent claim 1 is clear as written, Applicants have amended independent claim 1 to further clarify the invention. In particular, independent claim 1 now recites that "the powder/gas conditioning chamber has a length along a longitudinal axis of equal to or greater than 20 millimeters to provide a residence time that the particles are exposed to the main gas between the gas/powder exchange chamber and the nozzle." Claim 1 further recites that the residence time is sufficient to increase a temperature of the particles "between the gas/powder exchange chamber and the nozzle" and facilitate adherence of the particles to the substrate "without heating the particles to a temperature above the melting temperature of the particles." As a result of these amendments, Applicants respectfully

submit that the rejection to claims 1-10 has been overcome. The Examiner has also indicated that dependent claim 21 is unclear for reciting that "the temperature of the particles is increased at least 150 degrees Kelvin as a result of the powder/gas conditioning chamber." Applicants have amended dependent claim 21 to recite that the temperature of the particles increase as the particles travel "in the powder/gas conditioning chamber from the gas/powder exchange chamber to the nozzle." As a result of these amendments, Applicants respectfully submit that the rejection to dependent claim 21 has been overcome.

Claims Rejections – 35 U.S.C. §103(a)

Claims 1-6 and 8-10 stand rejected under 35 U.S.C. §103(a) as being unpatentable over Van Steenkiste et al. (U.S. Patent No. 6,283,386) in view of Kay et al. (U.S. Pub No. 2001/0042508, now issued as U.S. Patent No. 6,502,767). Claim 7 stands rejected under 35 U.S.C. §103(a) as being unpatentable over Van Steenkiste et al. in view of Kay et al. and further in view of Schwarz et al. (U.S. Patent No. 5,273,957). Applicants respectfully traverse the rejection to independent claim 1.

Independent claim 1 defines over the cited prior art, either alone or in combination, by reciting a method of kinetic spray coating a substrate that requires, among other things, entraining particles of a powder into a flow of main gas in a gas/powder exchange chamber 49 and directing the entrained particles to a powder/gas conditioning chamber 80 disposed downstream of the gas/powder exchange chamber 49. The powder/gas conditioning chamber 80 has a length L along a longitudinal axis of equal to or greater than 20 millimeters to expose the particles to the main gas for a sufficient amount of time to increase a temperature of the particles without heating the particles to a temperature above a melting temperature of the particles. From the powder/gas conditioning chamber 80, the particles enter a converging diverging supersonic nozzle 54. The increase in temperature of the particles between the gas/powder exchange chamber and the nozzle facilitates adherence of the particles to the substrate.

Van Steenkiste et al. and Kay et al. disclose kinetic spraying systems that include a gas/powder exchange chamber for entraining particles of a powder into a main gas and directing the entrained particles into a nozzle, but they lack a powder/gas conditioning chamber disposed between the gas/powder exchange chamber and the nozzle that has a length equal to or greater than 20 millimeters. Notably, the inventive significance of the powder/gas conditioning chamber and its length equal to or greater than 20 millimeters (e.g. 240 millimeters) can easily be realized with reference to Figure 4 and Paragraph [0041] of the subject application. Here, the increase in temperature of the particles due to the existence of the powder/gas conditioning chamber, as compared to a system that only includes a gas/powder exchange chamber going directly to a nozzle, such as in Van Steenkiste et al. and Kay et al., can be realized by comparing reference lines 100, 102, and 104 to reference lines 106, 108, and 110.

Previously, Applicants argued that the increase in the particle temperature as recited in claim 1 has been found by the inventors to improve the adherence of the particles to the substrate and that neither Van Steenkiste et al. nor Kay et al. disclose, teach, or suggest increasing particle temperature, nor do they disclose, teach, or suggest that such an increase in particle temperature improves adhesion. In rebuttal, the Examiner responded with several arguments summarized as follows:

(1) Van Steenkiste et al. suggests that increasing a velocity of the particles from the nozzle improves adherence of the particles to the substrate and increasing a temperature of the overall gas/powder mixture increases particle velocity;

(2) Kay et al. teaches an adjustable powder feeder tube to adjust a length that the particles travel after exiting the powder feeder tube, but before entering the nozzle to "fine tune performance characteristics" of the system; and

(3) It would have been obvious to one skilled in the art, based on the teaching of the adjustable powder feeder tube in Kay et al., to increase the distance between the powder feeder tube and the nozzle of Van Steenkiste et al. to increase the overall gas/powder mixture

temperature in Van Steenkiste et al., which would also increase the particle temperature as a consequence thereof and improve adherence of the particles to the substrate.

As discussed further below, Applicants respectfully submit that there is no teaching, suggestion, or motivation to add the teachings of an adjustable powder feeder tube in Kay et al. to Van Steenkiste et al., as suggested by the Examiner, to render independent claim 1 obvious. Therefore, Applicants respectfully submit that the Examiner has not established a *prima facie* case for obviousness.

The problem faced by the inventors of the subject application in the field of kinetic spraying was increasing the efficiency of particle adhesion to a substrate, particularly for harder particles (e.g., nickel or nickel alloys) and larger particles (e.g., particles of greater than 50 microns), which in the past have not been successfully sprayed in an efficient manner (see paragraph [0004]). The powder/gas conditioning chamber and its length equal to or greater than 20 millimeters accomplishes these goals by: (1) increasing exposure of the particles to the main gas to increase particle temperature; and (2) increasing exposure of the particles to the main gas to provide more homogenous main gas/powder intermixing.

One skilled in the art, when faced with the problems confronted by the present inventors, would not look to Kay et al. for guidance and would not be motivated to add the teachings of Kay et al. to Van Steenkiste et al. Kay et al. is not concerned whatsoever with improving particle adhesion. Instead, Kay et al. was concerned with building a simpler nozzle configuration that is easily manufactured. Furthermore, Kay et al. would not be helpful to a person having ordinary skill in the art, since Kay et al. does not deal with harder or larger particles. In paragraph [0017], Kay et al. discloses using particles having a particle size of 10 to 40 microns, which are relatively small particles, as appreciated by those skilled in the art. Furthermore, nowhere does Kay et al. suggest that the system can be used with relatively harder particles (e.g., nickel or nickel alloys).

Conversely, Van Steenkiste et al. particularly focuses on using particles having a particle size of greater than 50 microns. In column 2, lines 23-32, Van Steenkiste states that the "present invention has succeeded in increasing the size of particles which can be

successfully applied by a kinetic spray process in excess of 100 microns....[it] has also been found that the deposit efficiency of the larger particles above 50 microns is substantially greater than that of the smaller particles below 50 microns." Van Steenkiste et al. further states in column 2, lines 55-59, "it is now recognized that the kinetic spray coating of metals and other substances using air entrained particles greater than 50 microns and up to in excess of 100 microns may now be accomplished..." These passages demonstrate that Van Steenkiste et al. actually teaches away from using particles that are smaller than 50 microns, such as in Kay et al. Thus, when faced with the problem faced by the inventors, which is to improve the adhesion efficiency of particles, particularly larger and harder particles, one skilled in the art would not be motivated to add the teachings of Kay et al.

The Examiner indicates on page 15 of the Final Office Action that the use of a longer gas/powder exchange chamber is explicitly desired by Van Steenkiste et al. in order to provide a higher overall gas/powder mixture temperature, which results in a higher particle velocity and better adherence of the particles to a substrate. The Examiner believes that one skilled in the art would be motivated to meet this desire by adding the teachings of the adjustable powder feeder tube in Kay et al. Applicants respectfully disagree. Applicants submit that Van Steenkiste et al. found that by reducing a diameter of the powder feeder tube, *not the length of the powder feeder tube*, there is less reduction of the temperature of the overall powder/gas mixture through the nozzle and better adherence of larger particles to the substrate. In other words, by reducing the *amount of relatively cooler air* directed into the gas/powder exchange chamber from the powder feeder tube, *less relatively cooler air has to be heated by the main gas*, and therefore, a temperature of the overall powder/gas mixture is not reduced to the same extent as when more relatively cooler air is used. Van Steenkiste et al. does not explicitly desire a longer gas/powder exchange chamber because a longer chamber would *actually increase* the amount of relatively cooler air that needs to be heated by the main gas. Thus, shortening the powder feeder tube's protrusion into the gas/powder exchange chamber *actually increases* the *amount of relatively cooler air that has to be heated*. Therefore, one skilled in the art would not be motivated to shorten the powder feeder

tube in Van Steenkiste et al. upon reviewing the desirability in Van Steenkiste et al. of *reducing the amount of relatively cooler air from the powder feeder tube to improve particle adhesion for larger particles*.

For these reasons, Applicants respectfully submit that independent claim 1 is in condition for allowance. Applicants also submit that dependent claims 2-10 and 21 are in condition for allowance based on their own merits, and based on their dependency to independent claim 1 and the failure of the references to suggest claim 1.

Applicants believe the application is now in condition for allowance, which allowance is respectfully solicited. Applicants believe that no additional fees are required. However, the Commissioner is authorized to charge our Deposit Account No. 08-2789 for any additional fees or credit the account for any overpayment.

Respectfully submitted,
HOWARD & HOWARD ATTORNEYS

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